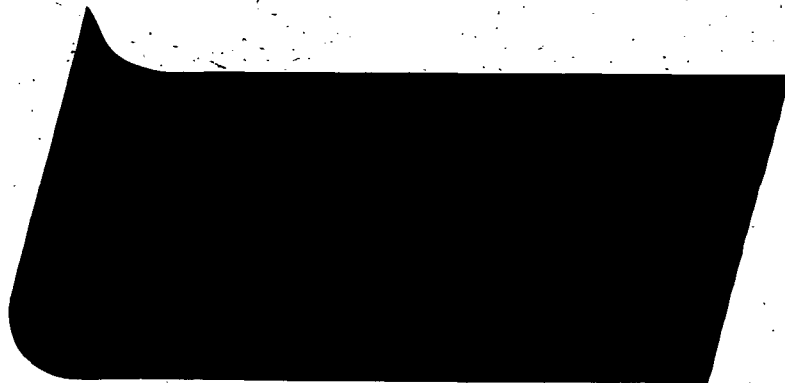




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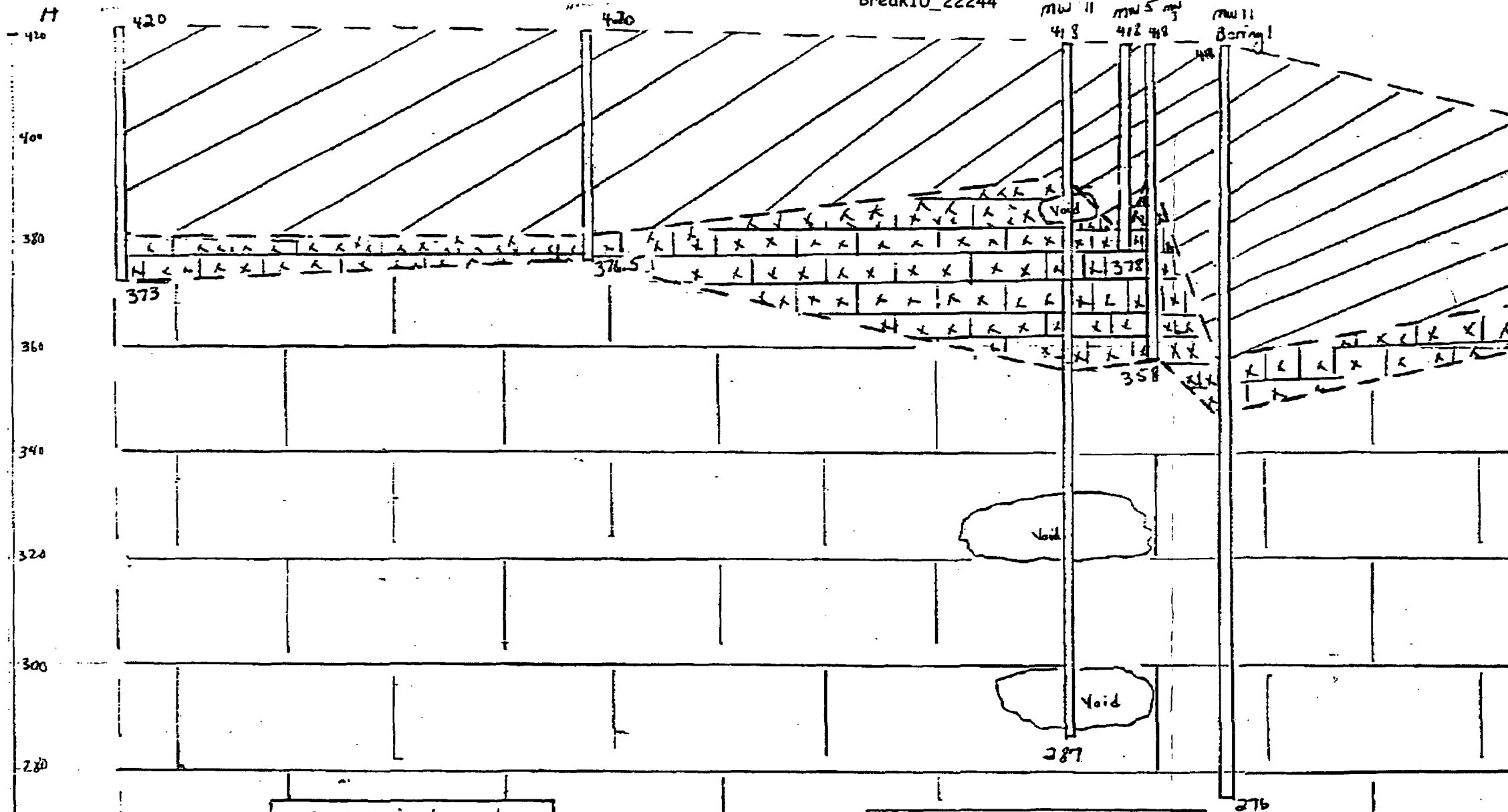
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S00154385  
SUPERFUND RECORDS

162161

MEW  
MOD980765982  
10.9  
SAMPLING  
WORK PLAN



Lithologic Legend

-  Silty clay with Limestone rock fragments
-  Weathered, broken Limestone
-  Unweathered Limestone

MEW ASSESSMENT

Horizontal Scale IS 1" = 44'  
Vertical Scale IS 1" = 20'  
Vertical Exaggeration IS 2X

**SUMMARY REPORT  
SUPPLEMENTAL HYDROGEOLOGIC  
FIELD INVESTIGATION**

**MISSOURI ELECTRIC WORKS  
CAPE GIRARDEAU, MISSOURI**

Prepared for:

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TETC Project 89-0363/09

April 1991

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**SUMMARY REPORT  
SUPPLEMENTAL HYDROGEOLOGIC FIELD INVESTIGATION**

**MISSOURI ELECTRIC WORKS  
CAPE GIRARDEAU, MISSOURI**

The following report summarizes the field and laboratory efforts undertaken by The Earth Technology Corporation (TETC) at the above referenced facility. On January 29, 1991 a boring program was started at the Missouri Electric Works property for the purpose of installing a deep monitor well (MW-11). In conjunction with this objective, the field program also included:

- Obtaining continuous rock core to be able to describe the stratigraphy under the site;
- Obtaining groundwater samples within the open borehole to determine the depth to which groundwater has been impacted;
- Performing packer tests across solution cavities and across competent rock sections within the open borehole to evaluate hydraulic conductivities in the various sections of the rock; and
- Obtaining samples of fine-grained materials within the surficial highly weathered rock zone and within a deeper solution cavity to ascertain differences in clay mineralogy.

In addition, existing monitor wells were also gauged, purged, and sampled.

The samples collected from the monitor wells were submitted to APR Laboratories, Incorporated of Dickinson, Texas under proper chain-of-custody control and analyzed for volatile organic compounds (VOCs), chlorinated hydrocarbons, and polychlorinated biphenyls (PCBs). This report serves to incorporate the information presented in our letter dated March 5, 1991 by summarizing all data collected during the field effort.

**BORING PROGRAM**

The drilling effort began on January 29, 1991. Prior to coring in competent rock a 6-inch outer steel casing was installed through the overburden to a depth of 60 feet below land surface. The boring for setting the outer casing was drilled using 8-inch outer diameter (OD) hollow-stem augers. Samples of the drill cuttings were examined by TETC's on-site hydrogeologist and a lithologic log was developed describing the texture and color of the material. The boring log for Boring #1 is included as Attachment A.

To adequately describe the subsurface material prior to well installation, a pilot hole through the rock was undertaken. To advance the hole and collect continuous rock samples, a drill rig equipped with an air coring device was used after the overburden material was cased-off. As the core was retrieved from the

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core barrel, the TETC on-site hydrogeologists recorded the rock characteristics, the drilling rate, and the recovery length.

Field measurements of the recovery length were used to calculate the Rock Quality Index (RQD). The RQD is a semi-quantitative description of rock quality, and the values are expressed as the cumulative length of the recovered core pieces 4 inches or longer divided by the length of the coring run. For core samples collected from the pilot boring, the rock quality was generally 75 percent to 90 percent and designated as good quality.

Additionally, to assess the background concentrations of PCBs in the vicinity of Boring #1, a soil sample was collected from a depth of 6 to 12 inches below the ground surface and submitted to the analytical laboratory on January 31, 1991. The laboratory reported the results for PCBs as not detected.

Upon advancing the core barrel to a depth of approximately 142 feet below the ground surface in Boring #1, the drill stem became locked in the hole and could not be retrieved. Apparently loose rock material from a solution cavity, intersected at the 142-foot depth, collapsed on the core barrel bit. Difficulties persisted with the next two hole attempts. Boring #2 was abandoned when bedrock was encountered at a depth of 16 feet below the ground surface. It is noted that a "sweet" chemical odor was observed in the clayey soils adhering to the augers during drilling of Borehole #2. Boring #3 was abandoned after the air hammer bit became lodged at a depth of 59 feet below the ground surface.

The fourth hole (Boring #4), where monitor well MW-11 was constructed, is located approximately 12 feet west of the first hole, and it is located by monitor wells MW-3 and MW-5. Boring #4 was successfully advanced to a depth of approximately 121 feet below the ground surface before intersecting of another large solution cavity. Because the drill rig was not equipped to drive casing, and the uncased solution cavity would divert the drilling fluid, a decision was made to set a monitor well with 5 feet of screen from approximately 115 feet to 120 feet below the ground surface.

Having passed from unconsolidated overburden material to hard bedrock at a depth of approximately 26 feet in Boring #4, the 8.25-inch outside diameter (OD) hollow-stem augers were removed and the hole advanced to a depth of approximately 70 feet with a 4.75-inch OD air rotary bit. Since the rock had been cored during the field effort of January 28th to February 8, 1991, a complete lithologic description was available. Therefore only the drill cuttings from the air rotary operation were collected and logged by the TETC on-site hydrogeologist. During the hole advancement, particular attention was given to the drilling rate as an indication of the passage of the drill bit through zones of heavily fractured rock and solution cavities. Upon reaching a depth of 70 feet, the tools were removed and a 7.875-inch OD air hammer was inserted to ream and condition the hole for acceptance of the outer casing. The outer casing consisted of a 5-inch diameter Schedule 40 steel pipe. A rigid tremie line was used to place the cement-bentonite grout mixture in the annular space around the outer casing. The grout was composed of approximately 6 to 8 pounds of bentonite powder per 94-pound bag of cement mixed with 8 to 10 gallons of water. The grout was thoroughly mixed with a recirculating pump, and the annulus was grouted from the bottom to the top.

After allowing the grout to stand for approximately 18 hours, the outer casing installation was complete. At this point, the hole was advanced from a depth of approximately 70 feet to a depth of approximately 131 feet with a 4.75-inch OD air rotary bit. The advancement rate was fairly constant from 70 feet to

approximately 120 feet, and the fracture zones and solution cavities encountered were generally less than 1 foot thick. At a depth of approximately 121.5 feet, a major solution cavity was intersected by the drill bit, and the drill string quickly dropped to a depth of approximately 130 feet before again encountering hard rock. The hole was advanced another foot and at a depth of 131 feet, where drilling was halted to prevent the loss of more drilling tools due to the inability to case-off the solution cavity. The flow of tan muddy silt and clay brought from the cavity to the ground surface by the compressed drilling air was measured at approximately 30 gallons per minute.

Before continuing to advance the hole, an attempt was made to clear the cavity of its silt load. Water was purged from the cavity for approximately 1 hour at a rate of approximately 30 gallons per minute using the drill rods as a conductor pipe and compressed air as the lifting mechanism. After 60 minutes, no significant change was noted in either the flow rate or the color of the water. Because the yield from the cavity was so large, the decision was made to construct a well so that samples from the solution cavity could be collected. A discussion of the well installation effort is presented in the Monitor Well Installation section of this letter report.

#### **MONITOR WELL INSTALLATION**

The monitor well was constructed of 2-inch diameter Schedule 40 PVC screen and riser pipe, flush-jointed and fitted with a PVC bottom end cap. The well screen measured 5 feet in length and consisted of 0.01 inch slot openings. Using a rigid tremie pipe, the sand pack was inserted from the screen bottom to a height of approximately 4 feet above the screen. The partially collapsed hole at a depth of approximately 121 feet supported the sand pack during installation. Next, approximately 4 feet of bentonite as a thick slurry was pumped to the top of the sand pack and allowed time to settle before introducing the cement/bentonite grout. The grout mixture consisted of approximately 6 to 8 pounds of bentonite powder per 94-pound bag of cement mixed with 8 to 10 gallons of water. The completed well was brought to a height of approximately 2.5 feet above the ground surface and fitted with a locking steel stand pipe. The stand pipe measured 5 feet in length and was inserted over the PVC riser pipe and pushed into the grout. The riser pipe was fitted with a PVC cap, and the well was secured with a weather-resistant lock to prevent unauthorized access. After allowing the grout to settle for approximately 24 hours, the annulus was topped-off with grout, and a conical apron of concrete was built to seal the space between the locking stand pipe and the outer steel casing to prevent precipitation infiltration. The well construction diagram is presented as Attachment B.

#### **WELL DEVELOPMENT**

The well was developed within 2 hours following construction using the air-lifting method. A trailer-mounted air compressor provided the air which was passed through a clean carbon filter before being transferred to the well. The carbon filter served to remove any hydrocarbons that may have been introduced to the compressed air stream. All well development equipment was steam-cleaned with high-pressure steam prior to well development.

The well was pumped at a rate of approximately 2 gallons per minute under an air pressure of 110 pounds per square inch. During well development, the well was surged by quickly blocking air flow into

the well. As a result, water movement across the sand pack and screen was reversed to dislodge fine grained particles. Several times during the well development procedure, the flow rate was measured to assess the well development progress. During that time, grab samples from the well discharge point were collected and examined. Of the five grab samples collected during the well development procedures, none were observed to contain unusual colors or odors. Although the heavy silt load from the solution cavity never cleared, sufficient pumping time was allowed, and well development was halted after 60 minutes.

#### WATER LEVEL DATA COLLECTION

Prior to purging and collecting groundwater samples from the existing monitor wells on January 30 and January 31, 1991, a round of groundwater measurements was collected on January 29, 1991. During the remainder of the field effort, three rounds of water level measurements were obtained because of the steep hydraulic gradient that was noted during the analysis of the January 29th water level data. The subsequent three rounds of water level measurements confirmed 6.5-foot drop in groundwater elevations between monitor wells MW-9 and MW-7. The groundwater elevation data collected during this phase indicate a significantly different potentiometric surface than data collected on March 15, 1990. Table 1 summarizes the groundwater level data collected during the field effort. The groundwater contour map for the data collected on March 15, 1990 as well as maps showing the groundwater elevations measured on January 29, 1991, February 14, 1991, February 15, 1991, and February 20, 1991 are included A Attachment C.

Water levels were monitored in monitor wells MW-3 and MW-5 while well MW-11 was purged to assess the response in these wells during the purging process. The data is summarized in Table 2. During the purging of monitor well MW-11, water levels could not be measured accurately from MW-11 because of access restrictions from the drill rods and conductor piping. Groundwater was pumped from MW-11 from a depth of between 113 feet and 119 feet below the ground surface at an approximate rate of 10 gallons per minute. As groundwater was purged, the water levels in MW-3 and MW-5 fluctuated upward and downward. For MW-3, the depth to the water level increased 0.18 feet (2.2 inches) during the first 18 minutes of measurements, but after 18 minutes of purging, the water level decreased 0.08 feet (1 inch) over the next 20 minutes. For MW-5, the depth to the water level increased 0.17 feet (2.0 inches) during the 28 minutes of measurements. The data indicate that there may be a hydraulic connection between the upper and lower water-bearing zones.

Following the development of MW-11, the water level was allowed to equilibrate before collecting a set of groundwater level measurements from MW-11, MW-3, and MW-5 on March 1, 1991. These wells are within 15 feet of each other and serve as a well cluster whereby hydraulic head data at different depths within the aquifer system can be measured. Referencing the ground surface as a datum, and assuming the ground surface to be horizontal, the well screen for MW-11 is set between approximately 115 feet and 120 feet, the well screen for MW-3 is set between approximately 47 feet and 57 feet, and the well screen for MW-5 is set between approximately 35 feet and 40 feet. Depth to water measurement in these three wells were obtained on March 1, 1991 and recorded as 54.62 feet for MW-11, 35.19 feet for MW-3, and 35.07 feet for MW-5. The lower hydraulic head value measured in the deeper well (MW-11) indicates a potential downward hydraulic gradient and that this well is in a separate water-bearing zone than the nearby shallower wells.

TABLE 1  
GROUNDWATER ELEVATIONS  
SUPPLEMENTAL HYDROGEOLOGIC INVESTIGATION  
MISSOURI ELECTRIC WORKS SITE

		29 January 1991		14 February 1991		15 February 1991		20 February 1991		1 March 1991	
Monitoring Well Number	Top of Casing Elevation	Depth to Water (ft)	Ground Water Elevation	Depth to Water (ft)	Ground Water Elevation	Depth to Water (ft)	Ground Water Elevation	Depth to Water (ft)	Ground Water Elevation	Depth to Water (ft)	Ground Water Elevation
MW-3	420.06	37.37	382.69	33.79	386.27	35.81	384.25	35.99	384.07	35.19	384.87
MW-4	422.72	39.92	382.80	37.61	385.11	37.93	384.79	38.56	384.16	--	--
MW-5	419.52	36.85	382.67	34.19	385.33	35.26	384.26	35.53	383.99	35.07	384.45
MW-6	424.22	41.56	382.66	39.24	384.98	39.51	384.71	40.14	384.08	--	--
MW-7	405.86	23.58	382.28	20.57	385.29	22.03	383.83	22.38	383.48	--	--
MW-8	401.74	18.97	382.77	19.04	382.70	18.95	382.79	18.68	383.06	--	--
MW-9	423.74	34.79	388.95	33.97	389.77	34.27	389.47	34.28	389.46	--	--
MW-10	423.15	39.35	383.80	37.92	385.23	37.20	385.95	37.38	385.77	--	--
MW-11	420*	--	--	--	--	--	--	--	--	54.62	365.38

\* Estimated top of casing elevation

**TABLE 2**  
**GROUNDWATER LEVEL MEASUREMENTS FOR**  
**MW-3 AND MW-5 DURING PURGING OF BOREHOLE**  
**MISSOURI ELECTRIC WORKS SITE**

Time (Hours)	MW-3		MW-5	
	Depth to Water (Feet)	Groundwater Elevation (Feet)	Depth to Water (Feet)	Groundwater Elevation (Feet)
1022	37.42	382.64	NM	
1023	37.41	382.65	NM	
1024	37.40	382.66	NM	
1026	37.38	382.68	NM	
1028	37.36	382.70	NM	
1029	37.35	382.71	NM	
1031	37.33	382.73	NM	
1032	NM		36.87	382.65
1033	NM		36.87	382.65
1034	NM		36.88	382.64
1035	NM		36.90	382.62
1037	NM		36.91	382.61
1038	37.25	382.81	NM	
1039	37.25	382.81	NM	
1040	37.24	382.82	NM	
1042	NM		36.93	382.59
1047	37.25	382.81	36.97	382.55
1055	37.28	382.78	37.02	382.50
1100	37.33	382.73	37.04	382.48

NOTE: Top of casing elevations for MW-3 and MW-5 are 420.06 feet and 419.52 feet, respectively.

NM = Not Measures

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### BOREHOLE PACKER TESTS

Packer tests were conducted in the fourth borehole on February 26 and 27, 1991. The test procedures and data analysis were performed in accordance with the method of computing rock mass permeability described by the U.S. Bureau of Reclamation (U.S. Bureau of Reclamation, 1974, Earth Manual, 2nd edition, Denver CO, pp 576 to 578.).

A total of four tests were performed at depths of approximately 113 feet to 119 feet (Test A), 102 feet to 108 feet (Test B), 82 feet to 88 feet (Test C), and 72 feet to 78 feet (Test D). The test intervals were spaced so as to incorporate different features of the limestone bedrock. Test A was conducted to determine the hydraulic conductivity of the rock in the vicinity of the large solution cavity which halted drilling advancement. Test B was conducted to gain an understanding of the hydraulic conductivity in the solid portion of the limestone bedrock. Test C was performed to assess the small void zone encountered during air rotary drilling. Test D was performed to assess the hydraulic conductivity of the solid limestone rock immediately below the bottom of the outer steel casing. Each packer test was conducted at different water injection pressures that were sustained for 10 to 15 minutes. During the tests, data were recorded for the elapsed time, packer inflation pressure, water injection pressure, volume of water flow into the rock, and the depth to water in the borehole (Attachment D).

The data was analyzed using the equation shown in Attachment D to compute hydraulic conductivity values. The results indicate that the hydraulic conductivity varies with depth and decreases with increasing depth. The hydraulic conductivity was calculated as  $10^{-6}$  cm/sec for the Test A interval,  $10^{-3}$  cm/sec to  $10^{-4}$  cm/sec for the Test B interval,  $10^{-4}$  cm/sec for the Test C interval, and  $10^{-5}$  cm/sec for the Test D interval.

### TRANSFORMER SURVEY

Between February 21, 1991 and February 25, 1991, all transformers located on the gravel pad east of the facility building were inventoried. In all, 153 transformers were identified and tabulated according to serial number, manufacturer, and fluid capacity and weight. Those transformers without serial numbers were photographed, and the photographs and field inventory are presented as Attachment E.

### QUALITY ASSURANCE/QUALITY CONTROL

All drilling, sampling, and well development equipment were thoroughly decontaminated before use. The drilling and well development equipment was decontaminated by steam-cleaning with high-pressure steam. Also, the well screen and riser pipe, as well as the steel outer casing, were steam-cleaned before construction. The Teflon bailers were decontaminated using a nonphosphate detergent wash followed by a minimum of three distilled water rinses. The bailers were allowed to dry before being covered to prevent passive contamination. Additionally, polypropylene bailing rope was used with the Teflon bailers to prevent the introduction of contaminants to the well.

To collect the samples, disposable Teflon bailers equipped with ball valve attachments were used. All sampling activities took place with personnel wearing Level D personal protective equipment, and clean protective surgical gloves were worn when filling the sample bottles. The collected samples were placed into precleaned containers equipped with Teflon-lined lids. After collection, the sample containers were immediately placed on ice and secured in a sealed cooler, and a chain-of-custody form was completed and included with the samples for prompt shipment via overnight delivery to the analytical laboratory. All sampling equipment was properly decontaminated prior to use at each sampling interval by the following procedure:

- wash with nonphosphate detergent and water,
- rinse with tap water,
- rinse with deionized water,
- air dry; and
- wrap sampling tools.

All appropriate quality assurance/quality control (QA/QC) samples, such as field duplicates and field blanks, were collected with the samples.

#### GENERAL GROUNDWATER SAMPLING METHODOLOGY

The volume of water to be removed from each well during purging was three times the well volume. The well volume was calculated by using the following equation:

$$V = (\pi)r^2(Dw-Dg)(7.48/144) = 0.16r^2(Dw-Dg)$$

where  $r$  is the radius of the well in inches,  $Dw$  is the depth of the well in feet, and  $Dg$  is the depth of the groundwater in feet. As purged water was removed from the well, it was collected in 5 gallon buckets and discarded at least 10 feet downslope of the well head.

To minimize the loss of VOCs during sampling, these samples were collected first and sealed with no air bubbles. Next, the chlorinated hydrocarbons were collected; followed by the PCBs and the water quality samples. All grab samples were collected using a decontaminated Teflon bailer, and all samples were placed into precleaned glass jars and placed on ice. The collected samples were kept under strict chain-of-custody control during shipment by overnight courier to APR Laboratories, Incorporated of Houston, Texas.

#### OPEN BOREHOLE SAMPLING METHODOLOGY AND RESULTS

To gain a qualitative understanding of water quality within the bedrock void and fracture areas, four open borehole samples were collected during the drilling effort. Two of the samples were collected from the first hole and the remaining two were collected from the fourth hole. The first sample was collected on February 3, 1991 at a depth below the ground surface of approximately 81 feet after purging the hole of approximately 11 gallons by hand-bailing with a Teflon bailer. The second sample was collected on February 5, 1991 at a depth below the ground surface of approximately 124 feet after purging

approximately 60 gallons by air lifting. The third and fourth samples were collected from the fourth hole on February 20, 1991 and February 27, 1991, respectively. The third sample was collected at a depth of approximately 57 feet after purging approximately 10 gallons by hand-bailing with a Teflon bailer. The fourth sample was collected at a depth of approximately 111 feet after purging approximately 360 gallons by air-lifting. Both the third and the fourth samples were collected to characterize the water quality of groundwater migrating through the more transmissive void areas of the limestone bedrock.

The open borehole water samples were analyzed for VOCs, chlorinated hydrocarbons, and PCBs. The analytical results are summarized in Table 3. The results indicate that chlorinated hydrocarbons and PCBs were not detected in the 81 and 124 foot samples from Borehole #1. However, for both samples, select VOCs were detected. For Boring #1, 81 feet, and Boring #1, 124 feet, chloroform was reported at levels of 7 micrograms per liter (ug/l) and 11 ug/l, respectively. Also, for Boring #1, 124 feet, bromodichloromethane and 1,1,1-trichloroethane were reported at concentrations of 5 ug/l and 6 ug/l, respectively. However, both chloroform and bromodichloromethane were detected in a field blank sample of the drilling water and both compounds are common constituents of chlorinated potable water supplies where the drilling water was obtained.

Compared with the results for the Boring #1 sample series, the results for Boring #4, 57 feet, and Boring #4, 111 feet, indicate greater concentrations of chlorinated hydrocarbons and the presence of PCBs. PCBs were not detected in the 111 foot sample, but were indicated (semi-quantitatively) in the 57 foot sample at between 5 ppb and 10 ppb. Also, as shown in Table 2, elevated concentrations of chlorinated hydrocarbons were reported for the Boring #4 sample series, but VOCs were reported to be below the detection limit for Boring #4, 111 feet. It is noted that water derived from the 57-foot depth in Borehole #4 was observed to have a "sweet" chemical odor.

## MONITOR WELL SAMPLING METHODOLOGY AND RESULTS

### Existing Monitor Wells

After measuring the water levels in the existing wells, the purge volume was calculated and three times the well volume was removed from each well before collecting water samples. All equipment was decontaminated in accordance with the procedures discussed in the Quality Assurance/Quality Control section of this letter report. The samples were collected with disposable Teflon bailers, and a bailer was dedicated to each well. The well sampling occurred between January 30, 1991 and January 31, 1991. Upon collection, a chain-of-custody form was completed, and the samples were placed in a cooler and maintained at a temperature of approximately 4 degrees Celsius.

Analytical results are summarized in Table 4 and discussed below. For monitor well MW-11, the concentration of PCBs (Aroclor 1260) was reported at 69 ug/l by the analytical laboratory. For the equipment blank collected on March 1, 1991, the concentrations of PCBs was reported to be below the detection level of 0.1 ug/l. Chlorinated benzene compounds were detected in samples obtained from monitor wells MW-3, MW-7, and MW-11. For well MW-7, trichlorobenzene and tetrachlorobenzene were reported at concentrations of 65.5 ug/l and 5.1 ug/l, respectively. Chlorinated hydrocarbon analytes were detected at elevated concentrations in samples obtained from wells MW-3 and MW-11 as indicated in Table 4. No chlorinated hydrocarbons were reported above the detection limit for the equipment blank

TABLE 3  
RESULTS FOR GROUNDWATER SAMPLES - OPEN BOREHOLE SAMPLES  
SUPPLEMENTAL HYDROGEOLOGIC INVESTIGATION  
MISSOURI ELECTRIC WORKS SITE

ANALYSIS <sup>(1)</sup>	Boring #1 81 Feet	Boring #1 124 Feet	Boring #4 57 Feet	Boring #4 111 Feet	Drilling Water Blank <sup>(2)</sup>
<b>Volatile Organics</b>					
Chlorobenzene	<5.0	<5.0	154	<5.0	<5.0
1,1-Dichloroethane	<5.0	<5.0	6	<5.0	<5.0
Chloroform	7	11	5	<5.0	18
Bromodichloromethane	<5.0	5	<5.0	<5.0	8
trans-1,2-Dichloroethene	<5.0	<5.0	14	<5.0	<5.0
1,1,1-Trichloroethane	<5.0	6	8	<5.0	<5.0
Trichloroethene	<5.0	<5.0	10	<5.0	<5.0
<b>Chlorinated Hydrocarbons</b>					
1,2-Dichlorobenzene	<10.0	<10.0	67.4	9.1	<10.0
1,3-Dichlorobenzene	<10.0	<10.0	20.9	3.7	<10.0
1,4-Dichlorobenzene	<10.0	<10.0	18.8	5.7	<10.0
Trichlorobenzene	<1.0	<1.0	18.4	28.5	<1.0
Tetrachlorobenzene	<1.0	<1.0	112	<1.0	<1.0
<b>PCBs</b>					
Aroclor 1260	<0.1	<0.1	5-10	<0.1	<0.1

<sup>(1)</sup> All results expressed as ug/l

<sup>(2)</sup> Used during coring of Boring #1 only

**TABLE 4**  
**RESULTS FOR GROUNDWATER SAMPLES**  
**SUPPLEMENTAL HYDROGEOLOGIC INVESTIGATION**  
**MISSOURI ELECTRIC WORKS SITE**

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											QC SAMPLES			
ANALYSIS <sup>(1)</sup>	MW-3	MW-3 DUP	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9	MW-10	MW-11	TRIP 2/5/91	TRIP 2/4/91	TRIP 3/1/91	EQUIP 3/1/91
<b>Volatile Organics</b>														
Chlorobenzene	240	94	<5.0	29	<5.0	<5.0	<5.0	<5.0	<5.0	36	<5.0	<5.0	<5.0	<5.0
Dichlorobenzenes		J20		J15										
1,1-Dichloroethane	<5.0	8	<5.0	5	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Chloroform	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	9	<5.0	<5.0	<5.0	<5.0
Bromodichloromethane	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
trans-1,2-Dichloroethene	35	20	<5.0	9	<5.0	<5.0	<5.0	<5.0	<5.0	12	<5.0	<5.0	<5.0	<5.0
1,1,1-Trichloroethane	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	6	<5.0	<5.0	<5.0	<5.0	<5.0
Trichloroethene	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	17	8	<5.0	<5.0	<5.0	<5.0
<b>Chlorinated Hydrocarbons</b>														
1,2-Dichlorobenzene	58.5	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	76	NA	NA	NA	<10.0
1,3-Dichlorobenzene	9.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	22	NA	NA	NA	<10.0
1,4-Dichlorobenzene	6.5	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	19	NA	NA	NA	<10.0
Trichlorobenzene	78.0	<1.0	<1.0	<1.0	1.0	65.5	<1.0	<1.0	<1.0	26.2	NA	NA	NA	<1.0
Tetrachlorobenzene	16.0	<1.0	<1.0	<1.0	1.0	5.1	<1.0	<1.0	<1.0	<1.0	NA	NA	NA	<1.0
<b>PCBs</b>														
Aroclor 1260	NA	NA	NA	NA	NA	NA	NA	NA	NA	69	NA	NA	NA	<1

<sup>(1)</sup> = All results expressed as ug/l  
J = Estimated concentration by analytical laboratory  
NA = Not analyzed

sample collected on March 1, 1991. Concentrations of VOCs were detected in the samples collected from wells MW-3, and its duplicate MW-3DUP, MW-5, MW-10, and MW-11. No VOCs were reported above the detection limit for the trip blank samples.

Lower quantification limits for 1,3-dichlorobenzene and 1,4-dichlorobenzene were achieved by the laboratory for sample MW-3. Hence, the results were quantified and reported on the laboratory data sheet (Table 4). Analysis performed on the duplicate sample, MW-3DUP, could not achieve these quantification limits and the results were reported as less than 10.0 ug/l. However dichlorobenzenes were detected at an estimated value of 20 ug/l in the duplicate sample on the chromatograph from the U.S. EPA 8240 analysis.

The data indicate the presence of VOCs and chlorinated hydrocarbons at detectable levels in groundwater in the overburden material and the areas of the limestone bedrock intersected by monitor wells MW-3 and MW-10. Additionally, PCBs are indicated in the deep portion of the limestone aquifer at a depth of approximately 115 to 131 feet below the ground surface in the vicinity of well MW-11. Further sampling rounds should be conducted to verify the initial laboratory results.

#### Water Quality Analysis

Within approximately 17 hours of developing monitor well MW-11, wells MW-11 and MW-3 were purged of 41 gallons and 11 gallons of well water, respectively and water quality samples were obtained from each. The groundwater samples were analyzed for cations (calcium, magnesium, potassium, sodium, and iron), anions (bicarbonate, carbonate, nitrate, sulfate, chloride), and total dissolved solids (TDS). Additionally, as discussed in the previous section, water samples were collected from well MW-11 for the analysis of VOCs, chlorinated hydrocarbons, and PCBs. The purpose of the water quality test parameters was to determine if water quality differs with depth through the aquifer system.

To ensure water samples that were representative of the aquifer, both monitor wells MW-11 and MW-3 were purged before sample collection. All sampling equipment was properly decontaminated before use, and the volume of water removed was calculated with the equation discussed in the General Groundwater Sampling Methodology section of this report.

The sample results for the water quality analysis are summarized in Table 5. The sample results for TDS in wells MW-11 and MW-3 were reported by the analytical laboratory at 195 milligrams per liter (mg/l) and 471 mg/l, respectively. Also, sample results for calcium, potassium, and iron showed similar results. With MW-11, the results were reported as 46 mg/l for calcium, 23 mg/l for potassium, and 3.2 mg/l for iron. The results for MW-3 were reported as 145 mg/l for calcium, 9.6 mg/l for potassium, and 0.14 mg/l for iron. For the anion analyses, the greatest difference in analyte results was reported for bicarbonate alkalinity; 78.4 mg/l reported for MW-11 and 353 mg/l reported for MW-3. These results generally indicate water quality that differs with depth.

#### CLAY MINERALOGY

On March 14, 1991, laboratory results were received from SCR Laboratories, Incorporated of Houston, Texas for two samples submitted by TETC for X-ray diffraction analysis. The samples were collected from

**TABLE 5**  
**RESULTS FOR GROUNDWATER SAMPLES**  
**GROUNDWATER QUALITY PARAMETERS**  
**SUPPLEMENTAL HYDROGEOLOGIC INVESTIGATION**  
**MISSOURI ELECTRIC WORKS SITE**

ANALYSIS <sup>(1)</sup>	MW-11	MW-3	MW-3DUP
Total Dissolved Solids	195	471	NA
Calcium	46.0	145	152
Magnesium	10.3	12.3	14.0
Sodium	58.0	55.0	51.0
Potassium	23.0	9.6	20.0
Iron	3.20	0.14	0.07
Chloride	27.0	15.0	NA
Nitrate	0.17	<0.01	<0.01
Sulfate	31.0	<1.0	NA
Carbonate	<1.0	<1.0	<1.0
Bicarbonate	78.4	353	129

<sup>(1)</sup> All results expressed as mg/l

NA Not Analyzed

the 142-foot to 142.5-foot depth interval in Boring #1 and from the 71-foot to 73-foot depth interval in Boring #4. Both samples consisted of loose material observed within fracture zones of the limestone bedrock. The results for the 142-foot to 142.5-foot sample indicated material that was predominantly quartz and calcite and which totaled 85 percent of the sample volume. Clay minerals as illite and kaolinite were detected and reported to total 12 percent of the sample volume. The remaining material was identified as apatite (two percent) and feldspar (one percent). The results for the 71-foot to 73-foot sample indicated material that was predominantly calcite and which totaled 95 percent of the sample volume. Clay minerals were identified as illite (three percent) and kaolinite (one percent). Quartz was identified and reported to be present as one percent of the sample volume. The laboratory results are included as Attachment F.

**ATTACHMENT A**

**Field Log of Boring**




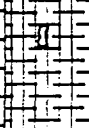

**MEW Site File  
Break10\_22260**

**Supplemental Hydrogeologic Field Investigation Report  
Missouri Electric Works, Cape Girardeau, MO  
TETC Project No. 89-0363/09**

# FIELD LOG OF BORING

DRILLING METHOD: HOLLOW STEM AUGER TO 60'; CORE BARREL 60'-142'  
 LOGGED BY: DAVID BOYLAN TETC PROJECT #: 89-0363  
 DATE DRILLED: 1/29 - 2/8/91 BORING #: MW-11 (First Hole)  
 DRILLING CO.: MATHES & ASSOCIATES, INC. EQUIPMENT: MOBILE B-90  
 TOTAL DEPTH: 142.0 FEET

Page 1 of 1  
 PROJECT NAME:  
 MISSOURI ELECTRIC  
 WORKS  
 CAPE GIRARDEAU, MO

DEPTH (FT)	LITHOLOGIC DESCRIPTION	GRAPHIC LOG	SAMPLES			TIME/RATE (fpm)	RQD PERCENT	CHEMICALLY ANALYZED SAMPLES
			TYPE	INTERVAL	NUMBER			
	Reddish tan fine sandy clay					AVERAGE 0.33		
	Yellowish tan silty clay							
20	Pale reddish brown silt and clay							
40	Reddish brown medium to fine gravelly clay; saturated 45'							
	Pale yellowish tan clay, soft							
60	Brownish grey Limestone. weathered, calcite-filled fine fractures with limonite staining, slight solutioning, few fossils, hard, dense					0.20	20	
	Unweathered bedrock 70.0 feet					0.13	80	
80	Highly fractured 72.0 - 72.9 feet					0.03	60	
	Void 81.5 - 82.5 feet					0.20	57	
100						0.20	100	
	Highly fractured 111.0 - 111.3 feet					0.08	100	
120	Loose circulation 119.0 feet					0.11	100	
	Void 134.5 - 137 feet					0.12	100	
	Void ("Mud Vein") 142.0 feet					0.20	100	
140						0.25	100	
	T.D. = 142.0 feet							

Key to Graphic Log:



CLAY



SILT



SAND



GRAVEL



VOID  
LIMESTONE



The Earth Technology Corporation \* Houston \* Texas

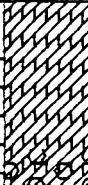



Break10\_22261

MEW Site File

# FIELD LOG OF BORING

DRILLING METHOD: HOLLOW STEM AUGER TO 26'; AIR ROTARY 26'-131'  
 LOGGED BY: DAVID BOYLAN TETC PROJECT #: 89-0363  
 DATE DRILLED: 2/19 - 2/24/91 BORING #: MW-11 (Fourth Hole)  
 DRILLING CO.: MATHES & ASSOCIATES, INC. EQUIPMENT: MOBILE B-90  
 TOTAL DEPTH: 131.0 FEET

Page 1 of 1  
 PROJECT NAME:  
 MISSOURI ELECTRIC  
 WORKS  
 CAPE GIRARDEAU, MO

DEPTH (FT)	LITHOLOGIC DESCRIPTION	GRAPHIC LOG	SAMPLES			TIME / RATE (fpm)	WELL CONSTRUCTION	CHEMICALLY ANALYZED SAMPLES
			TYPE	INTERVAL	NUMBER			
20	Reddish brown Silt and Clay grading to fine gravel 25'-26'					0.33		
40	Pale grey Limestone, hard, dense					0.11		
	Void 34.5 - 35.0 feet							
	Void 36.0 - 36.2 feet							
	Water Encountered 34.5 feet							
60	Fractured Limestone 57 - 59 feet					0.25		
80						0.25		
	Void 85.9 - 86.0 feet					0.33		
100						0.50		
120	Solution Cavity 121.5 - 130.0 feet					0.50		
140	T.D. = 131.0 feet							

Key to Graphic Log:



CLAY



SILT



SAND



GRAVEL



VOID  
LIMESTONE



The Earth Technology Corporation \* Houston \* Texas

MEW Site File  
 Break10\_22262

**ATTACHMENT B**

**Monitor Well Construction Log**

**MEW Site File  
Break10\_22263**

**Supplemental Hydrogeologic Field Investigation Report  
Missouri Electric Works, Cape Girardeau, MO  
TETC Project No. 89-0363/09**

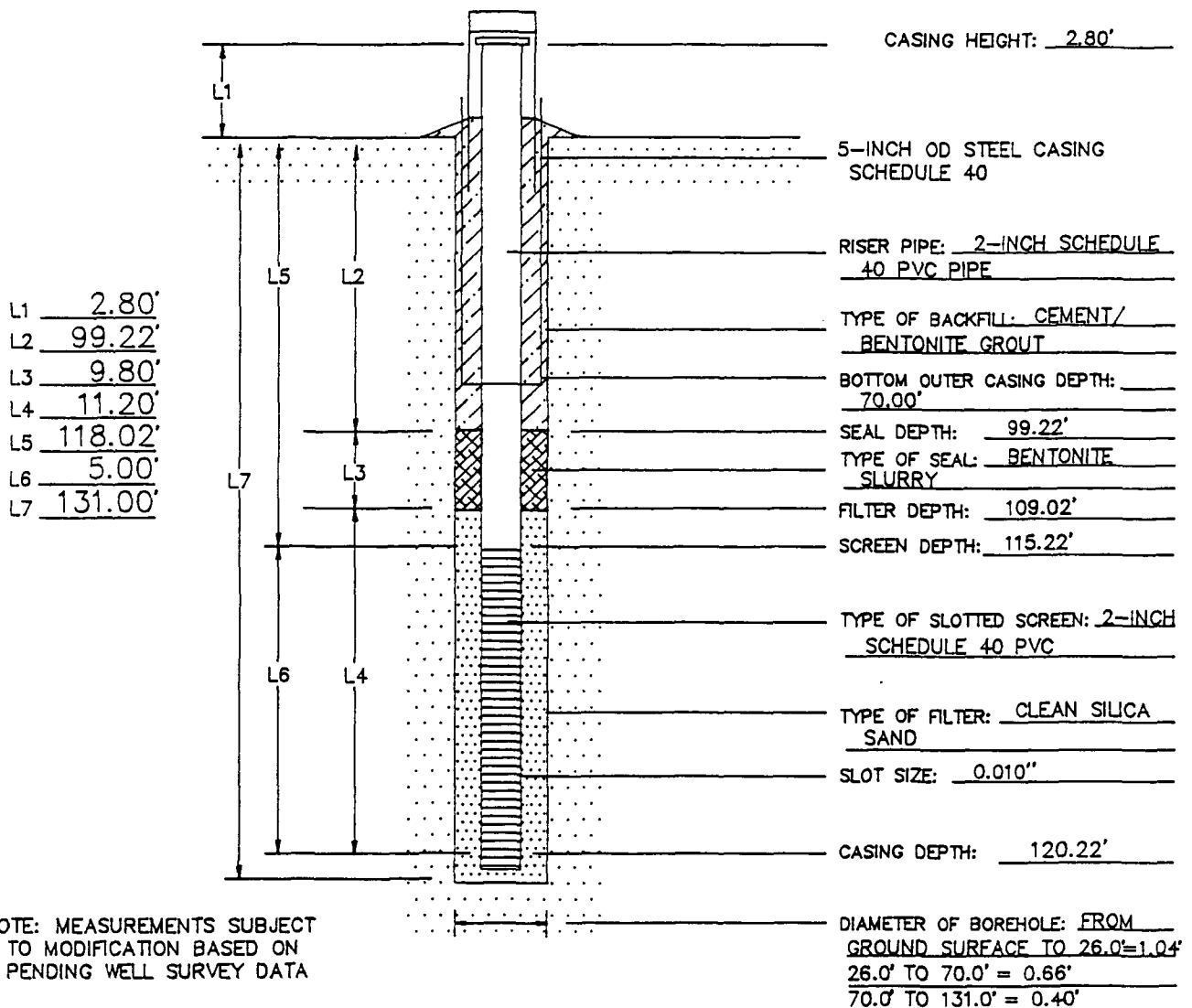
Monitor Well Number: 11

Project: MISSOURI ELECTRIC WORKS

Location: CAPE GIRARDEAU, MISSOURI

Date of Installation: 2/28/91

### MONITOR WELL CONSTRUCTION LOG

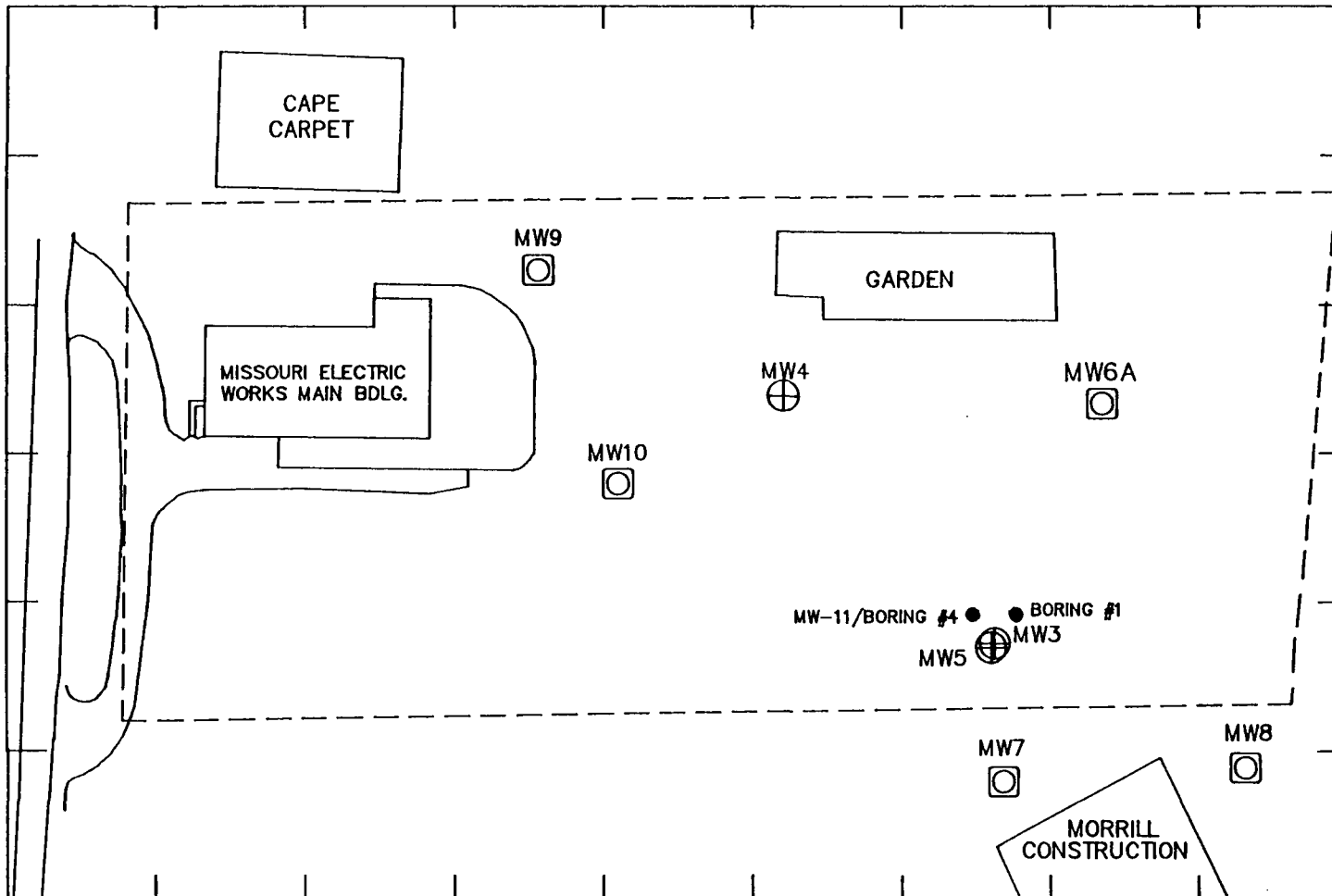


**ATTACHMENT C**

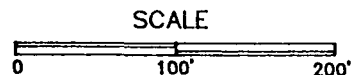
**Water Table Contour Maps**

**MEW Site File  
Break10\_22265**

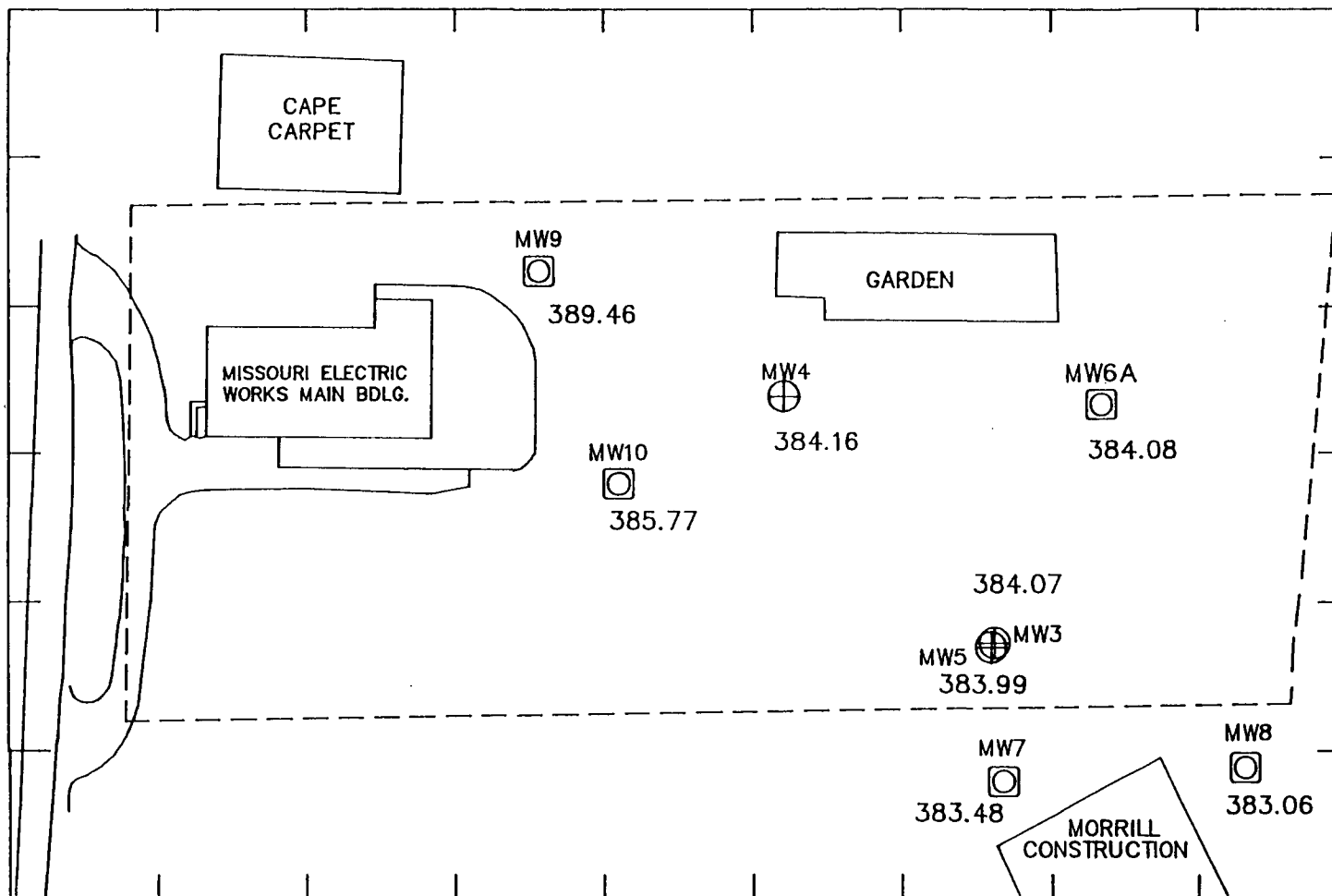
**Supplemental Hydrogeologic Field Investigation Report  
Missouri Electric Works, Cape Girardeau, MO  
TETC Project No. 89-0363/09**



MAP LEGEND	
	EXISTING MONITOR WELLS
	PHASE III MONITOR WELLS



	MISSOURI ELECTRIC WORKS SITE TETC PROJECT NUMBER 89-0363
APPROXIMATE LOCATIONS OF BORINGS #1 AND #4	
520 Post Oak Boulevard • Suite 750 • Houston • Texas • 77027	



MAP LEGEND

- ⊕ EXISTING MONITOR WELLS
- ⊞ PHASE III MONITOR WELLS

SCALE

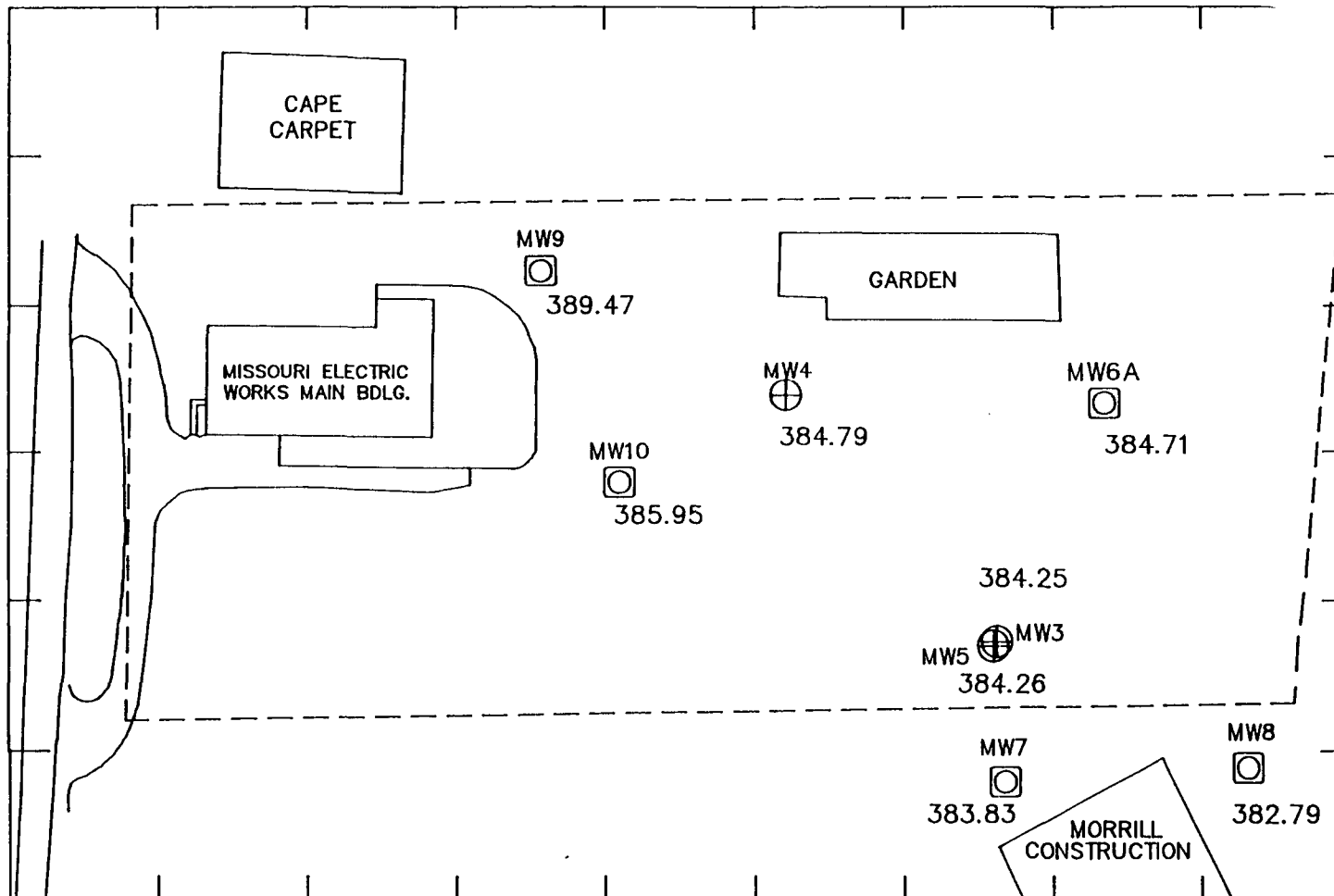


The Earth Technology Corporation

MISSOURI ELECTRIC WORKS SITE  
TETC PROJECT NUMBER 89-0383

GROUNDWATER ELEVATION DATA  
(FEET MSL)  
FEBRUARY 20, 1991

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MAP LEGEND

- ⊕ EXISTING MONITOR WELLS
- ⊙ PHASE III MONITOR WELLS

SCALE

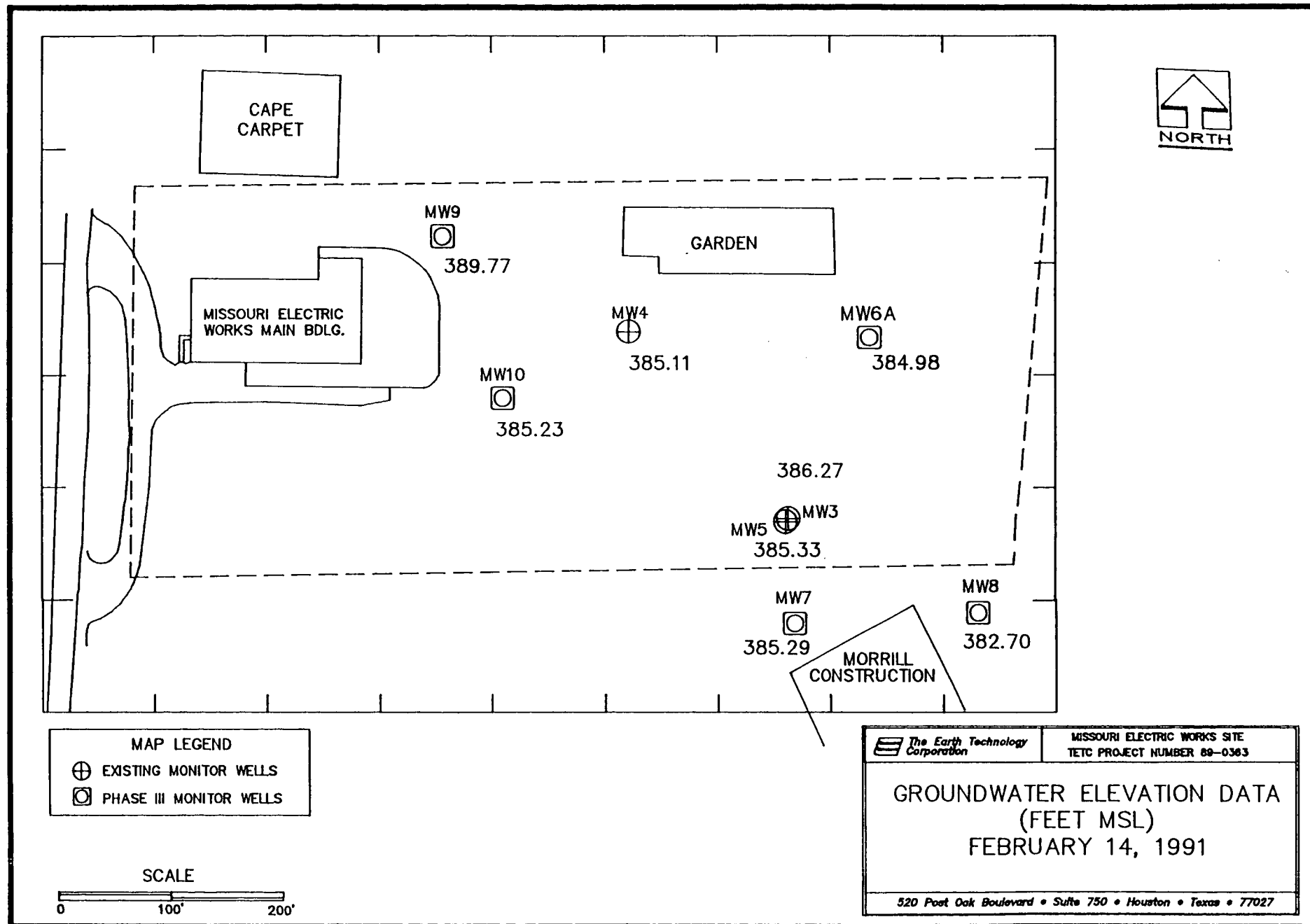


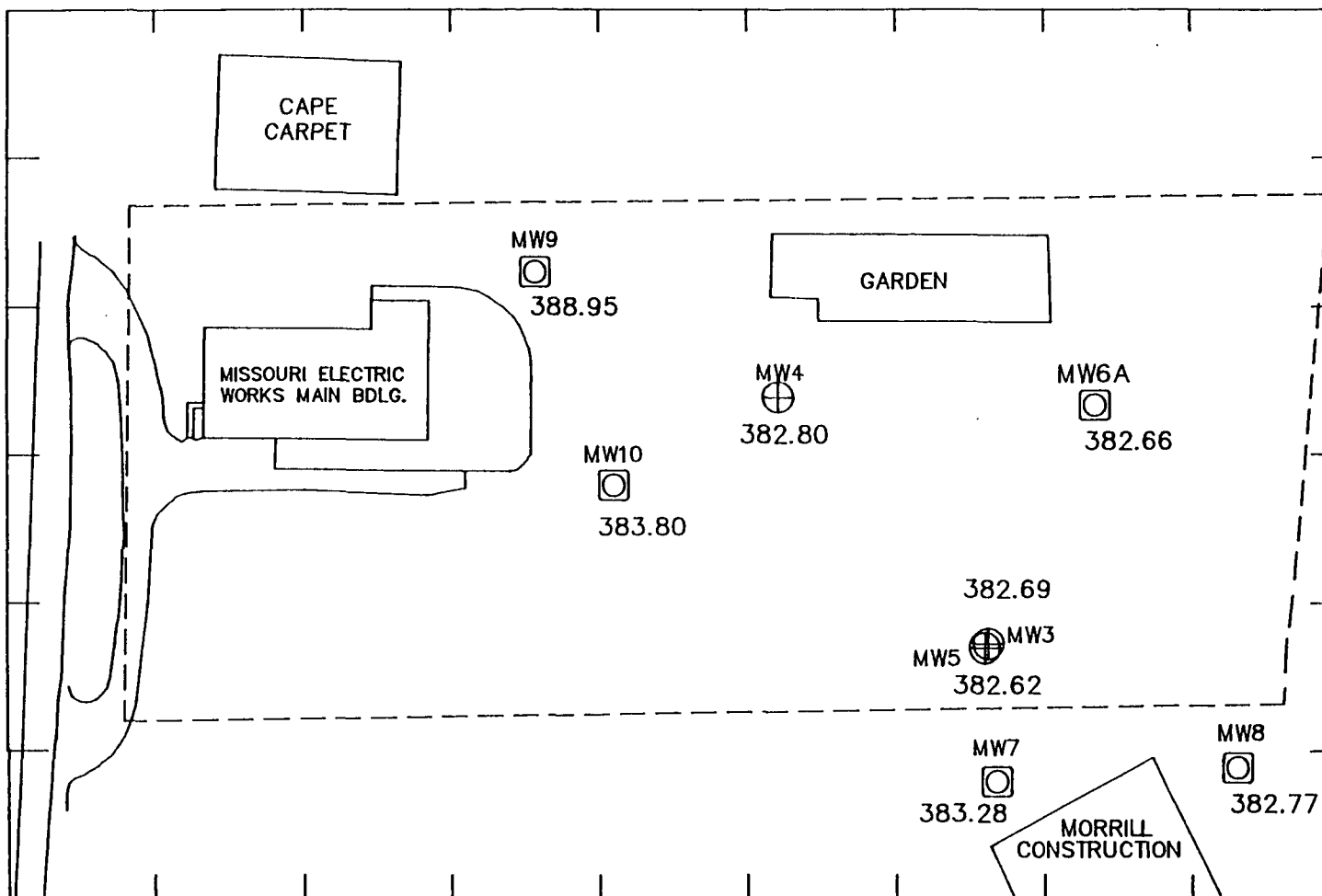
The Earth Technology Corporation

MISSOURI ELECTRIC WORKS SITE  
TETC PROJECT NUMBER 89-0363

GROUNDWATER ELEVATION DATA  
(FEET MSL)  
FEBRUARY 15, 1991

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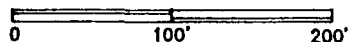




MAP LEGEND

- ⊕ EXISTING MONITOR WELLS
- PHASE III MONITOR WELLS

SCALE

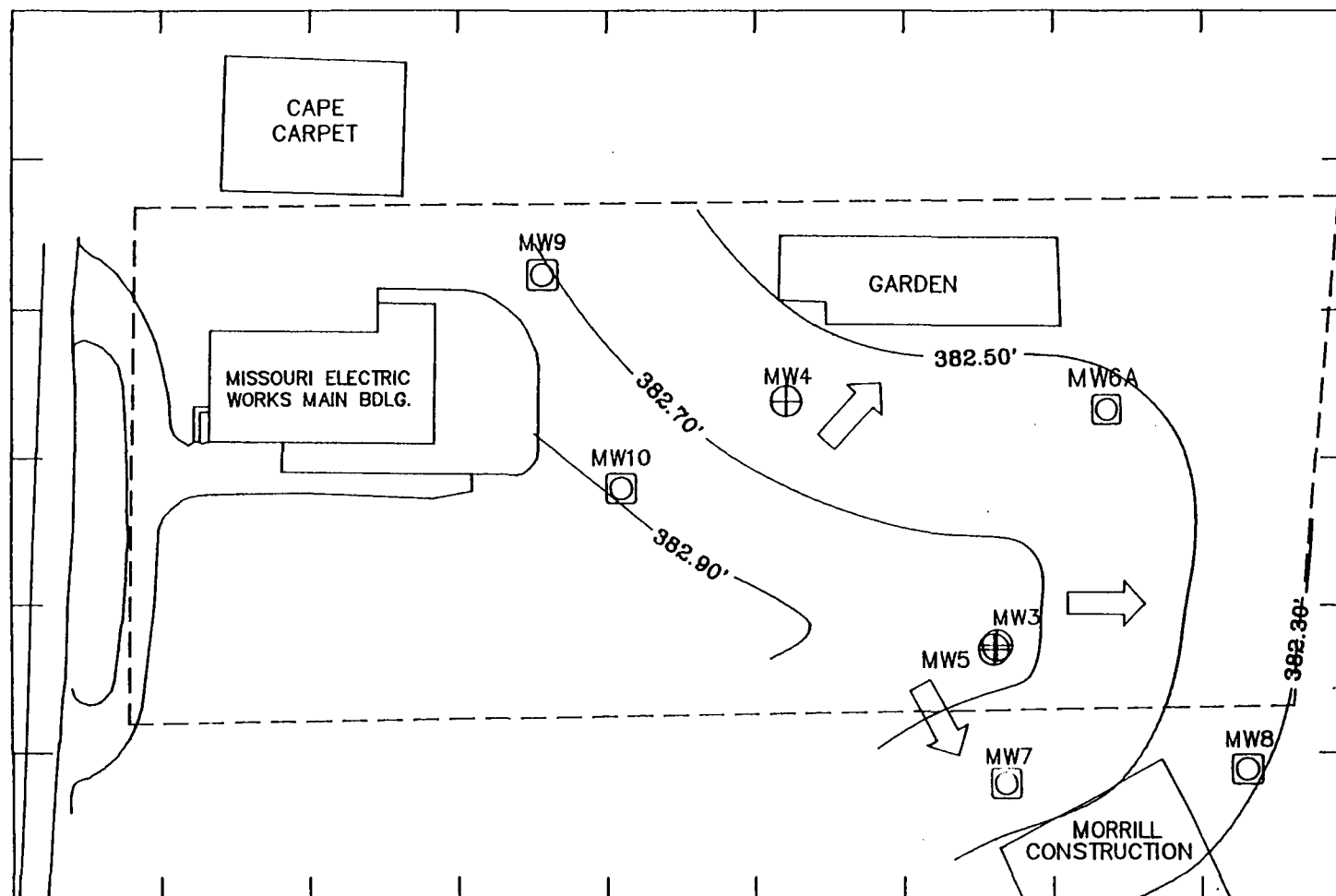


The Earth Technology Corporation

MISSOURI ELECTRIC WORKS SITE  
TETC PROJECT NUMBER 89-0363

GROUNDWATER ELEVATION DATA  
(FEET MSL)  
JANUARY 29, 1991

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MAP LEGEND

- ⊕ EXISTING MONITOR WELLS
- PHASE III MONITOR WELLS
- ➔ DIRECTION OF GROUND-WATER FLOW

SCALE



NOTE: GROUNDWATER ELEVATIONS USED IN  
CONSTRUCTION OF POTENTIOMETRIC SURFACE  
MAP OBSERVED MARCH 15, 1990.

POTENTIOMETRIC SURFACE CONTOUR INTERVAL = 0.20 FEET

 The Earth Technology  
Corporation

MISSOURI ELECTRIC WORKS SITE  
TETC PROJECT NUMBER 89-0363

POTENTIOMETRIC SURFACE MAP  
MARCH 15, 1990

520 Post Oak Boulevard • Suite 750 • Houston • Texas • 77027

**ATTACHMENT D**

**Packer Test Data and Calculations**

**MEW Site File  
Break10\_22272**

Borehole Radius:  $4 \frac{3}{4}'' = 0.40'$  (r)  
Packer Test Interval: 5.9' (L)

Since  $L > 10(r)$ , equation  $k = \frac{Q}{2\pi LH} \ln(L/r)$  is used

k = hydraulic conductivity, or coefficient of permeability  
Q = flow rate into hole  
L = test section length  
H = diff. head (Note: Interpreted to be difference of water level inside packer + water level of water storage tank)  
r = borehole radius

1440 min. = 1 day

MEW, Cape Girardeau, data collected 2/26/91  
Borehole #4

Test Section 113-119' ~ screened zone above void

Test time = 15 min. or 0.01 day

$$k = \frac{Q}{2\pi LH} \ln(L/r)$$

$$k = \frac{1 \text{ gallon}/.01 \text{ day}}{(2\pi)(5.9')(43.92)} \ln(L/r)$$

$$k = \frac{100 \text{ g/day}}{(1628.15\text{ft}^2)} (2.69)$$

$$k = (0.06 \text{ g/day/ft}^2)(2.69)$$

$$\begin{aligned} k &= 0.17 \text{ g/day/ft}^2 = 1.7 \times 10^{-1} \text{ g/day/ft}^2 \\ &= 8.02 \times 10^{-8} \text{ m/s,} \\ &= 8.02 \times 10^{-6} \text{ cm/s} \end{aligned}$$

$$\text{Data range} = 10^{-6} \text{ cm/s}$$

Test Section 102-108' ~ solid rock area 1:15-1:18

Test time = 3 min. or 0.002 day

$$k = \frac{Q}{2\pi LH} \ln(L/r)$$

$$k = \frac{4 \text{ gallons}/.002 \text{ day}}{(2\pi)(5.9')(38.42)} \ln(5.9'/0.4')$$

$$k = \frac{2000 \text{ g/day}}{(1424.26 \text{ ft}^2)} (2.69)$$

$$k = 1.40 \text{ g/d/ft}^2 (2.69)$$

$$\begin{aligned} k &= 3.78 \text{ g/day/ft}^2 = 3.78 \text{ g/day/ft}^2 \\ &= 1.78 \times 10^{-8} \text{ m/s} \\ &= 1.78 \times 10^{-4} \text{ cm/s} \end{aligned}$$

$$\text{Data range} = 10^{-3} - 10^{-4} \text{ cm/s}$$

Test Section 82-88' ~ void zone 2:15-2:30  
Test time = 15 min. or 0.01 day

$$k = \frac{Q}{2\pi LH} \ln(L/r)$$

$$k = \frac{98 \text{ gallons/.01 day}}{(2\pi)(5.9')(36.18')} \ln(5.9'/0.4')$$

$$k = 7.31 \text{ g/d/ft}^2(2.69)$$

$$\begin{aligned} k &= 19.66 \text{ g/day/ft}^2 = 9.28 \times 10^{-6} \text{ m/s} \\ &= 9.28 \times 10^{-4} \text{ cm/s} \end{aligned}$$

$$\text{Data range} = 10^{-4} \text{ cm/s}$$

Test Section 72-78' ~ rock immediately below outer casing 3:46-3:56  
Test time = 10 min. or 0.002 day

$$k = \frac{Q}{2\pi LH} \ln(L/r)$$

$$k = \frac{1 \text{ gallon}/.007 \text{ day}}{(2\pi)(5.9')(33.35')} \ln(5.9'/0.4')$$

$$k = .12 \text{ g/day/ft}^2 (2.69)$$

$$\begin{aligned} k &= .323 \text{ g/day/ft}^2 = 3.23 \times 10^{-1} \text{ g/day/ft}^2 \\ &= 1.52 \times 10^{-7} \text{ m/s} \\ &= 1.52 \times 10^{-5} \text{ cm/s} \end{aligned}$$

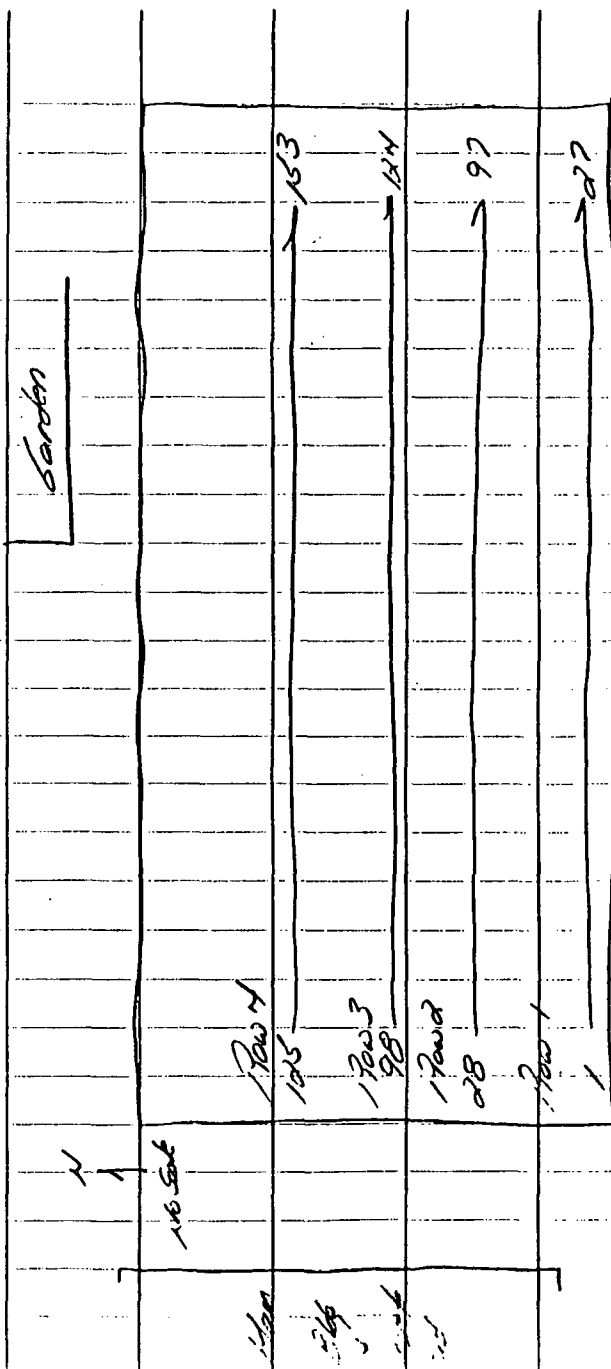
$$\text{Data range} = 10^{-5} \text{ cm/s}$$

**ATTACHMENT E**

**Transformer Inventory and Photographs**

MEW Site File  
Break10\_22278

Trans. Line	Serial <sup>1</sup>	Make	Height (ft.)	Cap. (gal.)
Start / Row 1				
1	881546	ME	1130	
2	881547	ME	1130	
3	879225	ME	1130	
4	848250	Wash- house	1255	
5	889253	GE		36
6	311411	Wash		20
7	71194 224?	Not Included		2300 gal
8	No id	255 gal. size		
9	No id	255 gal. size		
10	1116222	Line Material Company	3060	
11	532215	McLary Electric Co.		83
12	No id	255 gal. size		
13	5840022	Barta Star	1703	
14	2513538	Van Trip Electric		23.2
15	5328297-64P	GE	610	
16	7364611	GE	830	



Transducer	Serial #	Make	Depth (ft)
17	912539	Hobart	51
18	241249	GE	
19	7639423?	TD?	
20	10543	Line Hobart	1370
21	912200	Nagler	6560
22	5591293	GE	
23	3722999	Westphal	3030
24	250923	Kuhlman	Etc.
25	160994	Dowser	Etc.
26	1380285-5510	GE	5200
27	1380281-5510	GE	5200
End 1700.1			
Start 1700.2			
28	9686	Line Hobart	630
29	EB126029	Line Hobart	630
30	B14591	Kuhlman	395
31	B145803	Hobart	795
32	A86387	Kuhlman	395
33	51745535	Nagler	
34	353566	Nagler	
35	348860	Nagler	

Capacitor (19)					
71					
127					
4659					
5612					
270					
56					
51					
42709					
215					
215					
4159					
18					
18					
28					
14					
14					

MEW Site File  
Break10\_22281

Trans. Date	Serial #	Make	Depth (ft)
36	836244	Moham	1190
37	N/A	GE	
38	836929	Moham	1190?
39	9229618	GE	830
40	8600217?	?	
41	3460860	Phill's Chambers	
42	289323	Phill's Chambers	
43	6230158	GE	
44	348861	Wegart	
45	353153	Wegart	
46	211150?	?	
47	254808	Washburne	
48	994960	GE	
49	217259?	HE	
50	2052444	HE	575
51	1129884	HE	
52	2016529	HE	940
53	1138222	GE	
54	3191020	HE	
55	167221	Line Material	
56	6882313-674	GE	
57	6501884	Washburne	1325
58	9890316	GE	
59	2091370?	?	

Copy (9)				
2359?				
2239				
2159				
2209				
2359				
14				
14				
255				
110				
54				
2559				
16				
2509				
29				
235				
2509				
712				
2359				
30				
2559				

Trans. Rev.	Serial	Make	Model (Hr)	Age (yr)					
60	1594577	Allys Chambers		33					
61	B3999	ME	513	12					
62	3K20694	Apax		8.6					
63	B568362	GE		1109					
64	6894092	GE		21					
65	14850	ME		1359					
66	981467	Kuhlman	393						
67	51K10836	Washington		1459					
68	5406729	Apax		25					
69	2836177	Allys Chambers		25					
70	826149	Kuhlman		8.5					
71	C-169418-1-1	McGraw- Edison	1037						
72	F32628	Porter Co	812						
73	14572821	Washington	830						
74	3206392	Washington		1559					
75	238812	Luc Hobart		15					
76	192595	Washington	832						
77	5537549	Washington	830						
78	141950	Standard Trans. Co.	1638	21					
79	18852	?		1459					
80	2223021	Washington	34						
81	7878759244	Washington	1035						
82	20922-54	Central Trans. P. Corp.	1018	35					

Transformer	Serial #	Make	Weight (lbs)	Capac. (g)
83	20921-24	Central T. Co.	928	34
84	1202309-16	Central	1238	46
85	691008186	PTE Corp.	1025	41
86	20921-96	Central	928	34
87	21819-19	Central	925	35
88	1291015-11	Central	924	46
89	79221682322	Dewar Elec.	820	49
90	952000	Kuhlman		30
91	9888305	GE		30
92	9922506	GE		459
93	895412	Lux Metal	1620	
94	30434	Wagner Trans. Corp.	1280	38
95	63484	Optigra P. Mfg. Co.		59
96	30446	Wagner T. Co.	250	22
97	EB62381-644	GE	1065	
End / Pod 2				
Start / Pod 3				
98	2114832	Allis Chalmers	1650	21
99	9324624	GE		359
100	PB569	Wagner	2015	
101	BA2510?	?		459
102	343871	Allis Chalmers	1460	

MEW Site File  
Break10\_22284

Truss No.	Serial #	Make	Weight (lbs)	Cap. (gals)
103	57634425	Wishagh	790	
104	57634422	Wishagh	790	
105	68621489	Cartman	2410	
106	698871	Halary		36
107	600288	Wishagh	1375	
108	F524387-64P	GE	2600	10
109	L-14628-13-3	Larkin Larkin	835	38
110	951635	Kuhlman		62
111	57634424	Wishagh	790	
112	70014896	?		4759
113	954288	Kuhlman		19.5
114	5732568	Uopax		34
115	34462411	Allis Chalmers	915	
116	E971839-63P	GE	1100	
117	6881300	GE		36
118	63483	Optagraft		69
119	8132582	Wishagh		34
120	950835	Kuhlman		4309
121	4311469	Allis Chalmers	1125	
122	20162822	Danzer		45
123	5532922	Wishagh	1375	

MEW Site File  
Break10\_22285

Transducer	Serial #	Make	Depth (ft)	Core (g)
124	951825	Wagner	3000	
End Row 3				
Start Row 4				
125	9162822	GE	4000	116
126	?	Wagner		259 (dry phase / current box?)
127	1599854	GE/1115		63
128	F931608	Wagner		2659
129	6579825	GE		55
130	6579826	GE		55
131	6579824	GE		55
132	950352	Kuhlman		28
133	1511460	Wagner	1040	38
134	1224370	Line Mat	2500	
135	E-1709-10	PA Trans Co		102
136	951634	Kuhlman		62
137	240548	Maloney	1215	
138	11402821	Line Mat	360	126
139	6562994	GE		31
140	2830825	Wagner		40
141	553948/65P	GE	1330	
142	981126	Maloney	825	32

MEW Site File  
Break10\_22286

Transducer	Serial #	Make	Depth (ft)	Core (ft)
143	14012221002	Kahlman		215'g
144	336725	Kahlman		60
145	1978667	Phillips Chalmers		115'
146	3616	Easter <sup>3350</sup> For. Co.		79
147	1978668	Phillips Chalmers		115'
148	1618010	Line Mod	1625'	
149	1645766		1635'	
150	1550655		1625'	
151	1229030		1625'	
152	1232025		1625'	
153	1226090		1665'	
End Row 4.				



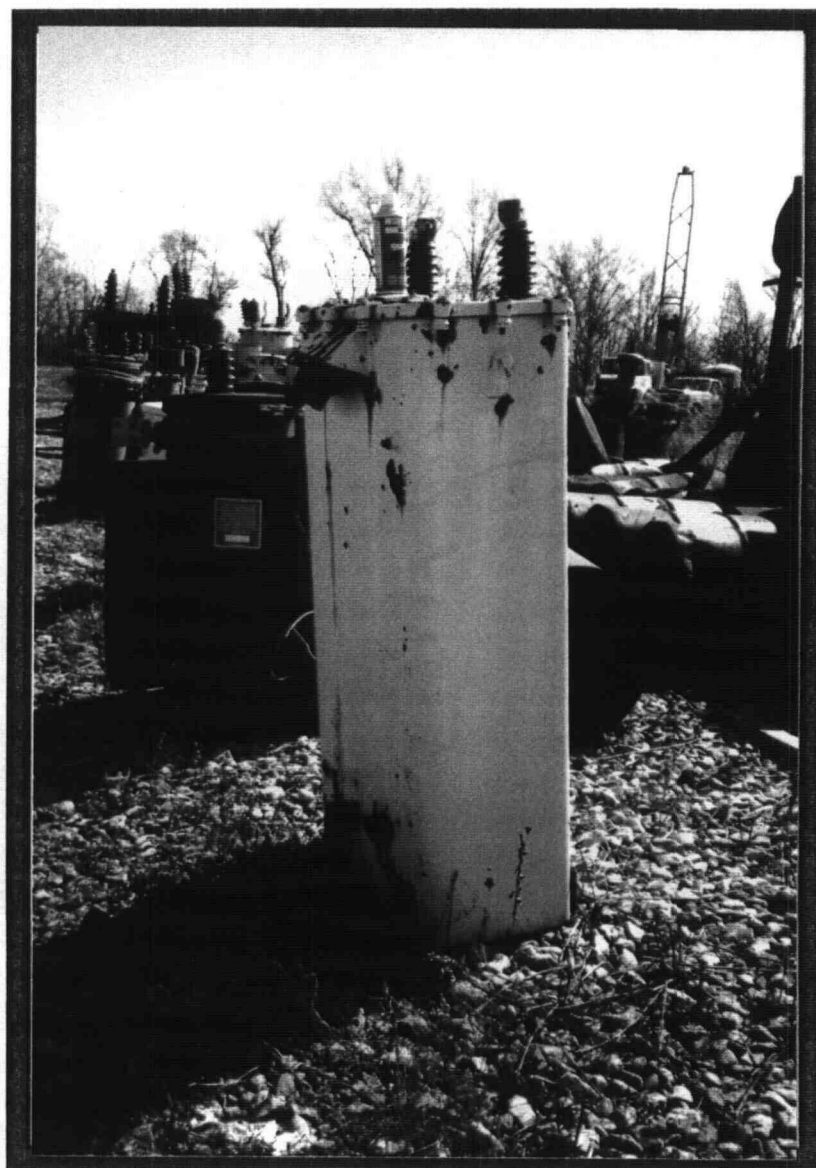
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#46**



**TRANSFORMER  
#79**



**TRANSFORMER  
#49**



**TRANSFORMER  
#12**

**MEW Site File  
Break10\_22288**

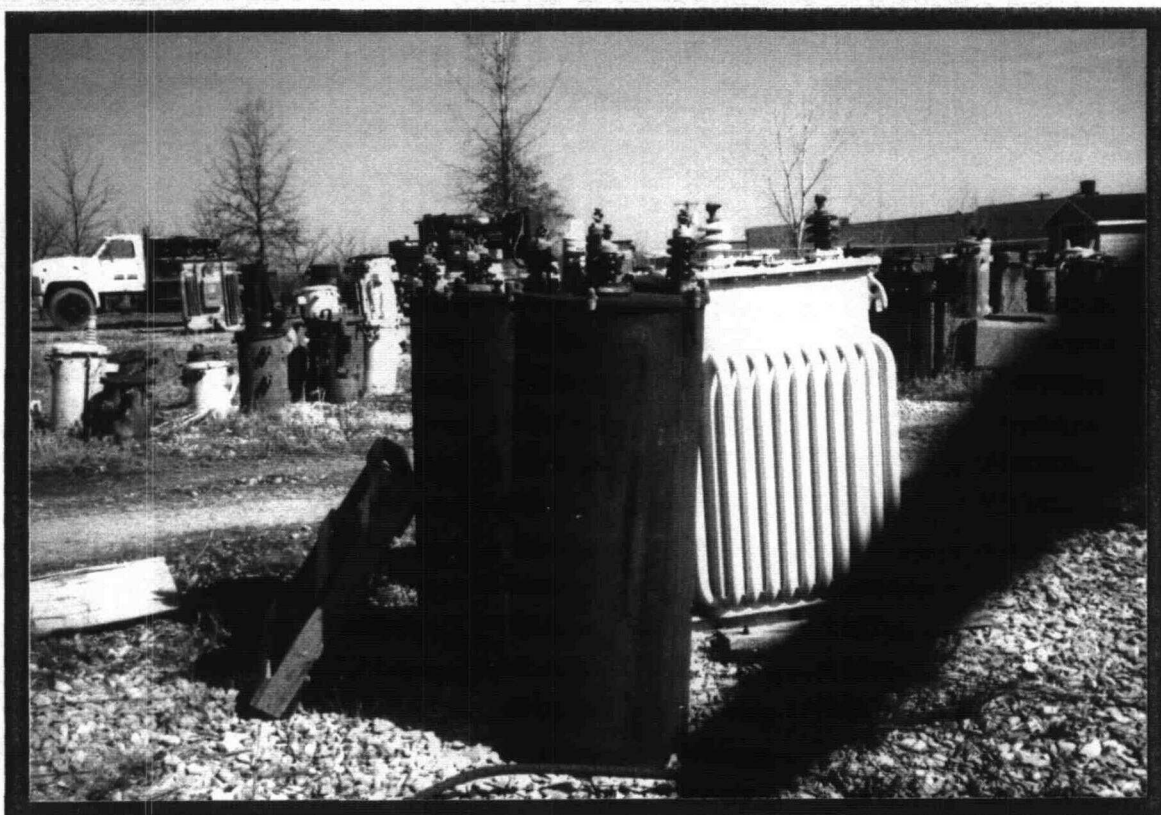


TRANSFORMER  
#126

TRANSFORMER  
#101



MEW Site File  
Break10\_22289



TRANSFORMERS  
#8 and 9

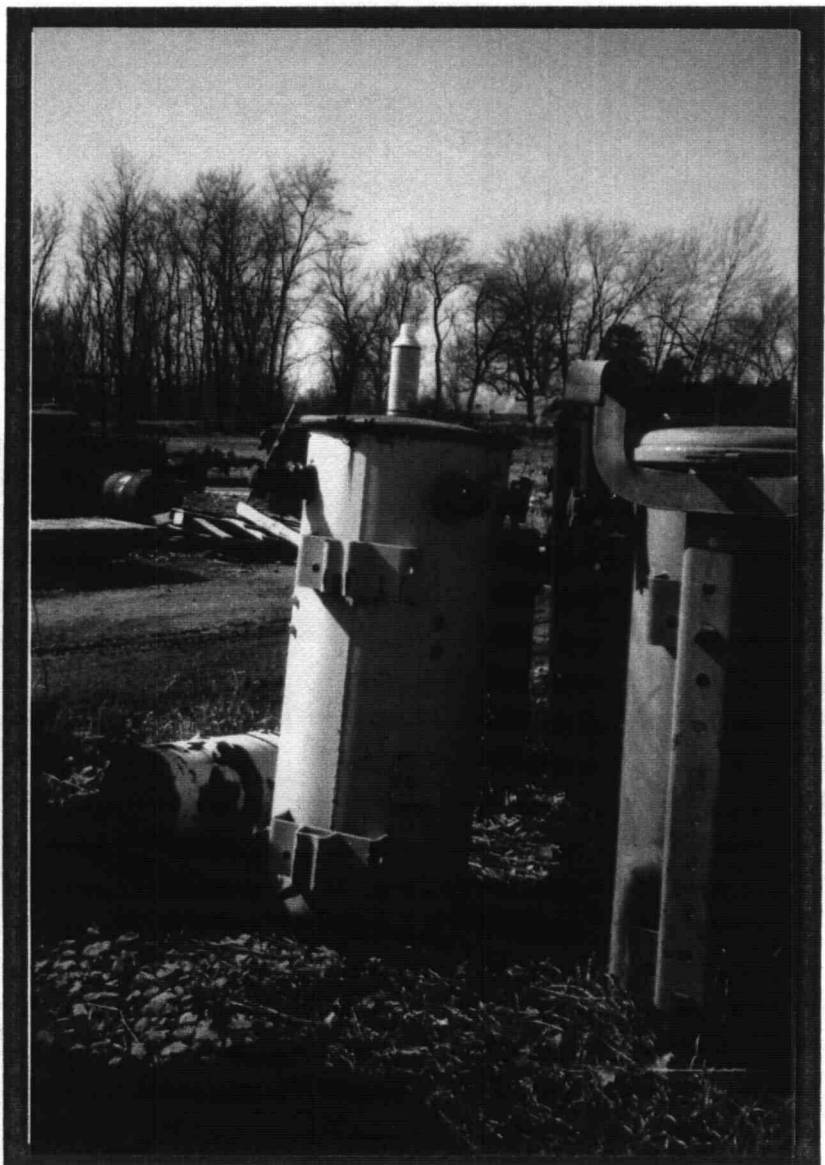
TRANSFORMER  
#7



MEW Site File  
Break10\_22290



TRANSFORMER  
#40



TRANSFORMER  
#59

**ATTACHMENT F**

**Clay Mineralogy Analytical Results**

**MEW Site File**  
**Break10\_22292**

**Supplemental Hydrogeologic Field Investigation Report**  
**Missouri Electric Works, Cape Girardeau, MO**  
**TETC Project No. 89-0363/09**



LABORATORIES, INC.

4800 West 34th, Suite A-12 • Houston, Texas 77092 • (713) 682-8738, 682-6739

March 14, 1991

TO: The Earth Technology Corporation  
520 Post Oak Blvd., Suite 750  
Houston, Texas 77027

Attention: R. Michael Nugent

LABORATORY REPORT NO.: 19517

P. O. NO.: Letter 3-8-91

SAMPLE DESCRIPTION: Soil Samples, MEW Cape Girardeau, Missouri,  
2-6-91, TETC Project No. 89-0363109

Diffraction Analysis

MW-11, 142-142.5'

Quartz	40%±
Calcite	45
Apatite	2
Feldspar	1
Illite	9
Kaolinite	3

B-11-4, 71-73' BLS

Calcite	95%±
Quartz	1
Illite	3
Kaolinite	1

Respectfully submitted,

M. E. Foster  
SCR Laboratories, Inc.

MEW Site File  
Break10\_22293